Commissioning of a multilayer monochromator for obtaining a high-flux beam from a multipole wiggler source

Kenji SAKURAI[1*], Mari MIZUSAWA[1] and Atsuo IIDA[2]
[1]National Institute for Materials Science, Tsukuba, Ibaraki 305-0047, Japan
[2]Photon Factory, Tsukuba, Ibaraki 305-0801, Japan

Introduction

A non-scanning XRF microscope [1] is a new procedure for the imaging of chemical composition. It uses quite a wide beam (12mm(H)×0.2mm(V)), which illuminates the whole sample surface in a grazing-incidence arrangement. The advantage is a short measuring time, typically around 1~2 min for one image (14 bit, 1M pixels) when using monochromatic X-rays at a bending magnet source. In order to consider more advanced experiments like real-time movies, a further strong photon flux is required. In the present research, a multiplayer monochromator has been designed as a multipole wiggler source.

Instrumentation

Fig 1 shows a photograph of a monochromator equipped with two multilayers (W/B_4C, 2d=50.36 Å, 125 layer pairs, 20mm×50mm×5mm, Osmic Co., Ltd.), both of which have independent stages for adjusting height and tilting. The other long translational stage ensures a constant height for the exit beam when changing X-ray energy. The 1st multilayer is cooled indirectly, i.e., supported by a water-cooled copper plate. The temperature is 22 ℃. The whole monochromator has been installed in a vacuum tank.

The experiment was carried out at BL-16A1. A single beamline-mirror (Rh coated, 4.5 mrad incidence) was used for rejecting high-energy X-rays. The present multilayer monochromator was placed in the experimental hutch (~35.5m from the source). A Si PIN detector (XR-100T, Amptek, energy resolution ~200 eV at 5.9 keV) was employed for measuring the X-ray energy of air scattering from an X-ray path. Ionization chambers are also used for monitoring intensity.

Results

Fig 2 shows typical spectra from air scattering. The energy band width is 578 eV at around 8 keV (~7%). The high-energy X-ray background is still visible, and therefore improving the signal to background ratio is necessary for XRF applications. In the present case, when 10 keV X-rays were used, the ratio improved notably and XRF imaging was achieved satisfactorily for the most part. Preliminary estimation indicates that flux intensity here is at least 100 times larger than that for a normal monochromatic beam at a bending magnet beamline. Some XRF movie experiments with the present monochromator are planned for the very near future. The authors wish to thank Drs. H. Sawa, Y. Wakabayashi and Y. Uchida for their assistance during the experiment.

References

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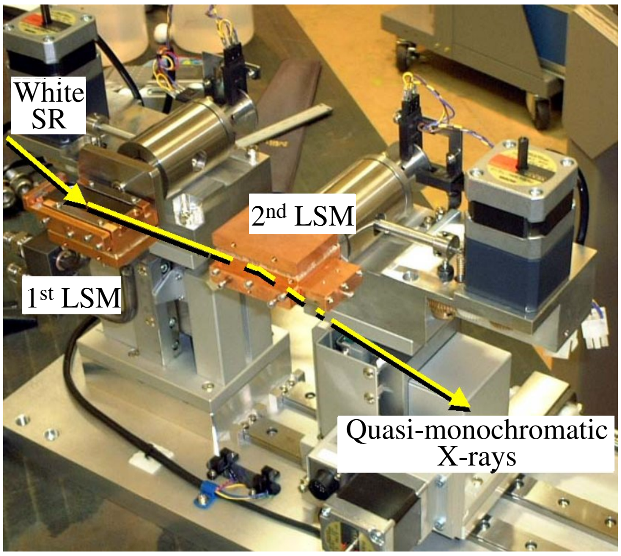
*sakurai@yuhgiri.nims.go.jp



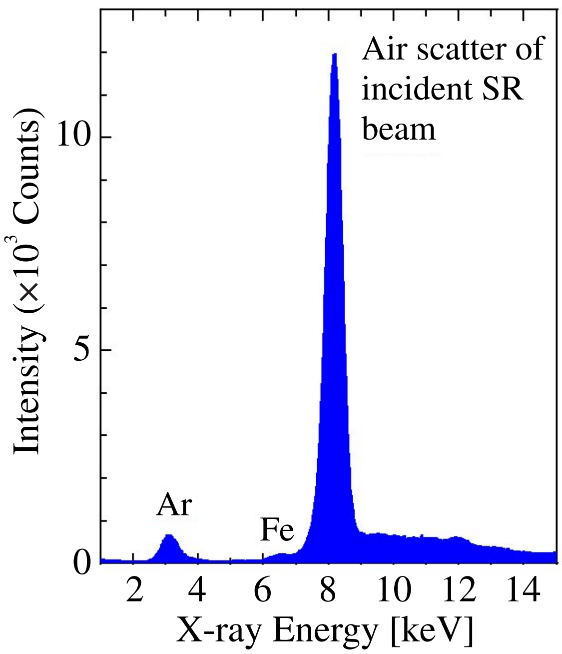


Figure 1 (up) A multilayer monochromator.
Figure 2 (right) Typical spectra for monochromatized X-rays. X-rays scattered by air were measured by an energy-dispersive detector.